OTEC Neg

SQ Solves

status quo investment and demonstration plant will spill over

Lockheed Martin 13 – American advanced Technology Company that has gone global (Lockheed Martin, "Lockheed Martin and Reignwood Group to Develop Ocean Thermal Energy Conversion Power Plant", 4/16/13, http://www.lockheedmartin.com/us/news/press-releases/2013/april/lockheed-martin-and-reignwood-group-to-develop-ocean-thermal-ene.html)

Lockheed Martin [NYSE: LMT] has announced that it is working with Reignwood Group to develop an Ocean Thermal Energy Conversion (OTEC) pilot power plant off the coast of southern China. A memorandum of agreement between the two companies was signed in Beijing on Saturday. Following the ceremony, both companies met with United States Secretary of State John Kerry during his first official state visit to the People's Republic of China. The 10-megawatt offshore plant, to be designed by Lockheed Martin, will be the largest OTEC project developed to date, supplying 100 percent of the power needed for a green resort to be built by Reignwood Group. In addition, the agreement could lay the foundation for the development of several additional OTEC power plants ranging in size from 10 to 100 megawatts, for a potential multi-billion dollar value.

Ext – SQ Solves

Happening in status quo – Lockheed Martin investing

Sustainable Business 10 – offer products and services that fulfill society's needs while contributing to the well-being of all earth's inhabitants (Sustainable Business, "Lockheed Martin Receives DOE Grants for Ocean Thermal Energy Conversion", 3/17/10, http://www.sustainablebusiness.com/index.cfm/go/news.display/id/19946)

The U.S. Department of Energy recently selected Lockheed Martin (NYSE:LMT) to receive two grants totaling $1 million to advance the technology commercialization of Ocean Thermal Energy Conversion (OTEC). The grants support the company's effort to produce an economically viable, utility-scale renewable energy source leveraging the temperature difference of the ocean's warm surface water and colder water below. Under the first grant, Lockheed Martin will develop a tool to estimate the amount of energy that can be extracted from the ocean's thermal layers. The geographic information system-based dataset and software tool will be used to identify regions of the world viable for OTEC and seawater-based air conditioning (SWAC). The resulting resource mapping will provide information to policy makers, the energy industry and the public about regional OTEC and SWAC feasibility. SWAC, which uses cold seawater located near coastlines to supply air-conditioner coolant, has the potential to significantly reduce electric utility loads during high summer demand periods and is a proven technology currently in use in Hawaii, Bora Bora, Stockholm and Ottawa. Under the second grant, Lockheed Martin will develop estimates of performance and life-cycle costs associated with utility-scale OTEC systems. The resulting data is expected to provide justification for pursuing commercialization of OTEC and generate investment interest. The Department of Energy grants follow an $8.12 million Department of Defense award to Lockheed Martin in September 2009. That contract from the U.S. Naval Facilities Engineering Command calls for development of critical OTEC system components and further matures its design for an OTEC pilot plant, an incremental step in developing large-scale utility plants. In 2008, Lockheed Martin received a $1.2 million Department of Energy contract to demonstrate how special cold water piping could be fabricated to carry the large volumes of seawater required to produce commercial power. Lockheed Martin's experience with OTEC technology dates back to the 1970s when the company built "Mini-OTEC." This early prototype remains the world's only floating OTEC system to generate power in excess of what is required for self-sustainment. Since that time, Lockheed Martin has continued to mature and validate the critical technologies necessary for an OTEC system that could generate a utility-scale power supply. Headquartered in Bethesda, Md., Lockheed Martin employs about 140,000 people worldwide and is principally engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. The Corporation reported 2009 sales of $45.2 billion.

Solvency/Enviro Turns

OTEC energy inputs gut solvency – too costly, net energy production too small, causes warming

Woodfard, 13 – British science writer, MA in Natural Science from Cambridge University, Author of multiple books including How Stuff Works, Cool Stuff, Cool Stuff 2.0, Cool Stuff Exploded (Chris Woodfard, "How Does OTEC Work?", Explain That Stuff, 12/2/2013, http://www.explainthatstuff.com/how-otec-works.html)

The biggest problem with OTEC is that it's relatively inefficient. The laws of physics (in this case, the Carnot cycle) say that any practical heat engine must operate at less than 100 percent efficiency; most operate well below—and OTEC plants, which use a relatively small temperature difference between their hot and cold fluids, have among the lowest efficiency of all: typically just a few percent. For that reason, OTEC plants have to work very hard (pump huge amounts of water) to produce even modest amounts of electricity, which brings two problems. First, it means a significant amount of the electricity generated (typically about a third) has to be used for operating the system (pumping the water in and out). Second, it implies that OTEC plants have to be constructed on a relatively large scale, which makes them expensive investments. Large-scale onshore OTEC plants could have a considerable environmental impact on shorelines, which are often home to fragile, already threatened ecosystems such as mangroves and coral reefs. Although OTEC plants are only suitable for tropical seas with relatively large temperature gradients, that's less of a problem than it sounds. According to DOE/NREL, OTEC could theoretically operate in 29 different sovereign territories (including warmer, southern parts of the United States) and 66 developing nations; and temperate parts of the world that can't operate OTEC most likely have alternative forms of ocean power they could exploit, including offshore wind turbines, tidal barrages, and wave power. Although OTEC produces no chemical pollution, it does involve a human intervention in the temperature balance of the sea, which could have localized environmental impacts that would need to be assessed. One important (and often overlooked) impact of OTEC is that pumping cold water from the deep ocean to the surfaces releases carbon dioxide, the greenhouse gas currently most responsible for global warming. The amount released is only a fraction (perhaps 10 percent) as much as that produced by a fossil-fueled power plant, however.

OTEC crushes ocean bio D and too inefficient for widespread adoption

Lowery 07 – A retired plant engineer, was in the U.S. Navy Propulsion Engineering School, Obtained a Master HAVC during his time at GM (C. Bruce Lowery, "PROS AND CONS OF OPEN AND CLOSED SYSTEM OTEC", Energy Consumers Edge, No Specific Date, http://www.energy-consumers-edge.com/closed_system_otec.html)

ENVIRONMENTAL FRIENDLINESS - Both open and closed system OTEC reach down about two thousand feet to the cold depths of the ocean. These systems will either involve power generating ships and power cables leading ashore, or they will be shore based facilities with large cold water intake pipes running along the ocean floor. Maybe the largest environmental concern about OTEC is the possibility of upsetting the thermal balance of the oceans if these systems are adopted in large numbers. While wide scale use of this technology is probably decades in the future, humanity needs to assess any potentially negative impacts on our oceans. For the present, the deep cold water that OTEC systems bring to the surface carries with it rich nutrients that create plentiful feeding grounds for near surface marine life. As OTEC systems create energy, they can also create some of the most plentiful fisheries known. Our history suggests that we will more fully assess environmental impacts of OTEC as its use grows. How fast use of this resource grows depends largely on its ability to compete against other power generation technologies. COST – OTEC power has historically been expensive because low temperature differences mean low system efficiencies; which translates to a lot of money spent on equipment for a low power output. The upsurge in fossil fuel prices, recognition of the full costs of fossil fuels (for example reclaiming land damaged by strip mining for coal), concerns about global warming, and energy security worries have caused investors to reexamine OTEC. The focus now is on combining OTEC with things like desalination for fresh water, cold root crop production, building cooling, or other enterprises. Any of the combined usages of cold water brought from the depths can mitigate electrical power generation costs

to make it economically competitive with conventional power generation. As of this writing, open system OTEC seems to have some advantages over closed system OTEC. Open systems are simpler in design and have the added bonus of providing fresh water with multiple secondary uses that economize plant operation. As discussed in this World Energy Council OTEC Report when all factors are considered, OTEC is competitive with fossil fuel electrical generation now. It's only a matter of proving that to investors. The report is full of OTEC information including diagrams of OTEC systems. AVAILABILITY – The most economical areas are those with high differences in temperature between surface waters and deep waters. These areas are found in the tropics in areas extending to about 20 degrees north or south of the Equator. According to U.S. Department of Energy National Renewable Energy Laboratory OTEC Information , the waters of the tropics absorb daily solar radiation equal in heat content to about 250 billion barrels of oil. The theoretical practical generating potential of OTEC is estimated to be about 10 Terrawatts. That much installed capacity operating 24 hours a day would generate 87,600 Terrawatt hours of electricity annually. How much electricity is that? Let's look at the numbers. [You will need the Free Adobe Reader to access some of the documents on this page.] DOE 2004 Global Electrical Production Data shows that we generated about 16,591 TWh that year. [TWh: Terrawatt hours – One million Megawatt hours, or one billion kilowatt hours, or about 3.44 Trillion Btus. Btu: British thermal unit; the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit.] In other words, fully exploited OTEC could provide over five times more electricity than is currently used globally. That's not to say that it would be practical to do so, however, since most of the prime OTEC waters are in the middle of the ocean and we live on land, at least most of us. AESTHETICS - It's difficult to fully assess aesthetic aspects of OTEC until we see how the potential plays out. Either open or closed system OTEC could be used in either onshore or offshore systems. If the economy of size proves out as it usually does in power generation, it could be that OTEC will develop with just a few, large onshore facilities with a number of very large, buried pipes leading offshore to deep, cold waters. But it could also happen that economics dictate that OTEC will work better on a number of sea-based platforms that combine OTEC with wind or wave generators. If that scenario proved out, we could see thousands of them bobbing around just offshore. It's really too early to tell.

Ext – No Solvency

Can't achieve price competitiveness

Choi 8 – Reporter for the Columbian Missourian, Contributing editor at Medicare Compliance Alert, Graduate teaching assistant at University of Missouri – Columbia (Charles Choi, "The Energy Debates: Ocean Thermal Energy Conversion", Live Science, 12/12/08, http://www.livescience.com/3155-energy-debates-ocean-thermal-energy-conversion.html)

Ocean thermal energy conversion requires a lot of money up front since the devices are massive undertakings, Penney explained. The pipes have to be wide or else the deep seawater rushes up too fast, heating up as it rubs against the sides — an intolerable consequence, since it needs to be cold. To get the cold water necessary, the pipes also have to extend down thousands of feet. Keeping the plants operating in the face of the corrosive saltwater environment and organic matter that inevitably clogs up the works could prove challenging also. "And for all that investment, you don't know if two months after you deploy it whether a tropical storm will then wipe it out," Penney said. Still, "the oil industry clearly knows how to put structures in place in the ocean and drill down to 15,000 feet. The technology is there — it could just be very costly." The environmental impact of OTEC remains murky. While nutrients in cold water from the deep could help aquaculture farms prosper, one question is whether they might also help unwanted life to grow as well. "And if you're pumping up billions of gallons from the depths, what might it change there?" Penney asked. "There's life down there too." One startling question is whether OTEC could divert the course of storms. "If you change ocean surface temperatures by even a few tenths of a degree, you could steer a storm," Penney said.

Construction costs mean can't be economically competitive

Green Diary 11 – providing information about different green technologies and ideas (The Green Diary, "The good, the bad and the ugly about ocean thermal energy conversion", 11/10/2011, http://www.greendiary.com/good-bad-ugly-ocean-thermal-energy-conversion.html)

The bad Transportation The OTEC plants need large pipes, nearly 3km long, for transporting the cold water from 1000m below the surface of the ocean to the plants on the shore. The cost of constructing the large pipes accounts for about 75% of the design cost. Discharging of the cold and warm seawater The warm and cold water discharged from the OTEC plants could affect the temperature of the coastal fringes. To avoid any adverse impact, the used seawater needs to be discharged at comparable temperature gradients. This further escalates the construction and maintenance costs of the plants. Can this be avoided? The high costs involved in transportation of cold seawater and construction of discharge pipes could be resolved by building floating OTEC facilities. However, a floating plant requires high mooring and maintenance cost. The ugly Cost The high construction and maintenance cost are the major deterrents in using OTEC as a renewable power source. The cost of producing electricity by an OTEC unit is approximately $0.07 per KW-hour. Developing countries lack the resource for constructing OTEC plants. Political concerns The floating OTEC plants are essentially artificial islands. Location of these facilities on the sea might lead to political debates regarding the jurisdiction of- the region. The boundary disputed that might erupt would inhibit utilization of the solar energy trapped in the seawater. Why are we so critical? The major criticism against the OTEC plant is the exorbitant cost of constructing the infrastructure for the facilities. The huge investment needed for building the OTEC plants would create a dearth of resources that might be otherwise used for financing the social sector.

OTEC fails [no large plant, cost, huge investment/risk, vulnerability to severe weather, environmentalist opposition]

Friedman 14 — Rebecca Friedman, AB from Harvard University, 2014 ("EXAMINING THE FUTURE OF OCEAN THERMAL ENERGY CONVERSION", *Harvard Political Review*, March, Available Online at http://www.oceanenergycouncil.com/examining-future-ocean-thermal-energy-conversion/, Accessed 7/29/14)

Despite the sound science, a fully functioning OTEC prototype has yet to be developed. The high costs of building even a model pose the main barrier. Although piecemeal experiments have proven the effectiveness of the individual components, a large-scale plant has never been built. Luis Vega of the Pacific International Center for High Technology Research estimated in an OTEC summary presentation that a commercial-size five-megawatt OTEC plant could cost from 80 to 100 million dollars over five years. According to Terry Penney, the Technology Manager at the National Renewable Energy Laboratory, the combination of cost and risk is OTEC's main liability. "We've talked to inventors and other constituents over the years, and it's still a matter of huge capital investment and a huge risk, and there are many [alternate forms of energy] that are less risky that could produce power with the same certainty," Penney told the HPR. Moreover, OTEC is highly vulnerable to the elements in the marine environment. Big storms or a hurricane like Katrina could completely disrupt energy production by mangling the OTEC plants. Were a country completely dependent on oceanic energy, severe weather could be debilitating. In addition, there is a risk that the salt water surrounding an OTEC plant would cause the machinery to "rust or corrode" or "fill up with seaweed or mud," according to a National Renewable Energy Laboratory spokesman. Even environmentalists have impeded OTEC's development. According to Penney, people do not want to see OTEC plants when they look at the ocean. When they see a disruption of the pristine marine landscape, they think pollution.

***Brackets in original text

Too Many Tech Barriers

Cooper et al 09 – This paper was presented at the 2009 Offshore Technology Conference held in Houston, Texas, USA (D.J. Cooper, L.E. Meyer, R.J. Varley, Lockheed Martin Corporation, "OTEC Commercialization Challenges", Offshore Technology Conference, 4/17/2009, http://www.gl-nobledenton.com/en/news.php?myPath=/en/news/11739.php)

The system level technical requirements for an OTEC plant can be simply stated as providing a desired number of kilowatt-hours to a specified location at a desired availability for a stated period of time. Meeting lower level derived requirements is not so simple. The fundamental characteristic of the ocean thermal resource is the relatively small temperature delta. Technologies required to convert those thermal resources into usable electric power account are the technology challenges. The immediate need is for heat exchangers that maximize thermal conductivity. The small temperature delta requires the need to move very large volumes of water at minimal pressure losses. Such mass transport translates into the need for large sea water pumps, large piping systems, and the large cold water pipe(s). Whether one chooses a closed-cycle or open-cycle design, turbine-generator sets are required to operate on relatively low temperature and low pressure vapors. When sufficiently close to shore, undersea power cables are required to survive in ocean environments and transition between static bathymetry to a dynamically moving platform or ship. The ocean environment drives technology challenges from three different perspectives: (1) mechanical/electrical operation in a corrosive and biologically active medium; (2) survival in adverse weather and ocean environments; and (3) minimization of impact to the environment. When one has addressed the detailed approach for each of these challenges, one still needs to integrate all of the pieces to make the whole system work. These technologies are not beyond today's state-of-the-art. Advances over the decades offer approaches that can be exploited for solutions. A major shift from the 1970's is seen in the offshore industry. Offshore oil and gas exploration and production platforms have moved from shallow waters to deep depths well beyond what is needed for initial moored OTEC plants. They operate reliably for long periods of time in adverse conditions. Multiple, mature platform options exist – spars; tension legs; floating production, storage and

offloading (FPSO) vessels; semisubmersibles, and plant ships. Our design team's trade studies over the past two years evaluated the various options. We have opted for a semisubmersible approach shown in figure 3. Cold water pipe design, deployment, and survival are a key technology challenge. Past cold water pipe failures slowed or halted many OTEC projects. Our design team trade studies have resulted in a sandwich composite design that will be fabricated on-site rather than be towed to the site. Validation of that approach is being conducted now under a cooperative agreement with the Department of Energy. Figure 4 depicts the fabrication sequence. As one segment of pipe is assembled, molded, and cured, it is lowered into the water to allow fabrication of the next segment. The result is a seamless, composite cold water pipe. A related technology challenge is the connection between the platform and the cold water pipe. This connection is arguably the biggest technical challenge since a cost efficient design has not been demonstrated over the time scales of a production platform. The connection design is intimately tied to the cold water pipe design and to the platform motion characteristics. We are in the process this year of detailing a connection approach compatible with our platform and cold water pipe decisions.

Environment Turn – Fish

OTEC particularly bad for fish populations

Aditya and Prakash 11 – They have B.techs in electronics and ECEs (Aditya and Prakash, "Abstract and full paper on Ocean Thermal Energy Conversion", Creative World 9, 10/1/11, http://www.creativeworld9.com/2011/03/abstract-and-full-paper-on-ocean.html)

OTEC plant construction and operation may affect commercial and recreational fishing. Fish will be attracted to the plant, potentially increasing fishing in the area. Enhanced productivity due to redistribution of nutrients may improve fishing. However, the losses of inshore fish eggs and larvae, as well as juvenile fish, due to impingement and entrainment and to the discharge of biocides may reduce fish populations. The net effect of OTEC operation on aquatic life will depend on the balance achieved between these two effects. Other risks associated with the OTEC power system are the safety issues associated with steam electric power generation plants: electrical hazards, rotating machinery, use of compressed gases, heavy material-handling equipment, and shop and maintenance hazards.

OTEC will disrupt natural habitats for sea plants animals

NOAA 10 – a federal agency focused on the condition of the oceans and the atmosphere (National Oceanic and Atmospheric Administration, "Ocean Thermal Energy Conversion: Assessing Potential Physical, Chemical and Biological Impacts and Risks", 7/26/2010, http://coastalmanagement.noaa.gov/otec/docs/otecjun10wkshp.pdf)

The physical presence, construction, and accidents group examined the potential physical, chemical and biological impacts associated with the physical presence, construction, and accidents associated with an OTEC facility. Construction impacts will vary with: location and design of the facility, extent of construction that takes place at sea, type and installation method of the power cable, and type of mooring selected. The platform will likely be built at a shore-based facility and towed to the site. The cold water pipe may be constructed on land and towed to the site, or constructed/manufactured on- site. The most disruptive aspects of installation are likely to be the placement of anchors, moorings and power cables. The installation and presence of these components may require blasting, drilling and excavation of the seafloor, and could disrupt benthic and pelagic communities, including deep corals and crustaceans, vertebrate fish, marine mammals, sea birds, sea turtles, invertebrates, and microbial communities. In particular, the installation and presence of the power cable will: increase suspended sediment, disturb or destroy coastal resources and coral reefs, as well as alter the behavior of invertebrate and vertebrate in the region. The installation of these components will disrupt habitat heterogeneity, and may have secondary long-term impacts to the ecosystem. Construction, installation and vessel traffic activities are likely to generate noise, and may disrupt movement and communication of fish, marine mammals and reptiles (e.g., whales, dolphins, sea turtles) in the area. Platform lighting may disrupt the normal behavioral patterns of sea birds, turtles, marine mammals, plankton, squid and fish in the region. Noise and EMF generated during construction and operation of an OTEC facility are addressed in Section E, Noise and EMF. The physical presence of the platform will most likely serve as a fish attraction device (FAD). This may increase the number of impinged and entrained organisms, and could change local migratory patterns. Accidental release of chemicals, while unlikely, has the possibility of disrupting all life within the plume and in the region surrounding the facility. Direct toxicity, chemical oxidation, and indirect toxicity (i.e., drop in pH increases certain metals, causing toxic effects) can potentially result from a chemical release.

OTEC has dangerous impacts on the environment — at best, effects aren't understood

NOAA no date — National Oceanic and Atmospheric Administration ("Ocean Thermal Energy Conversion (OTEC) Environmental Impacts", *NOAA*, Available Online at http://coastalmanagement.noaa.gov/otec/docs/environmentalfactsheet.pdf, Accessed 7/29/14)

The environmental impact studies from the 1980s concluded that the risks of OTEC would likely be acceptable, however; further environmental assessments and research are needed to address the following potential issues: Potential Impacts: 1. Withdrawal and Discharge Water: A 100 MW facility would use 10-20 billion gallons per day of warm surface water and cold water from a depth of approximately 3300 feet (1000 meters). The impacts of discharging this large volume of water in the ocean needs to be better studied. The water discharged from OTEC facilities will be cooler, denser and more nutrient rich due to the composition of the deep cold water being different from the receiving waters. Nutrient rich water (with nitrogen and phosphorus) would likely be discharged at a depth where the ambient water is warmer and oligotrophic (nutrient poor). The resulting indirect and cumulative impacts to marine biota and the dynamics of the marine ecosystem from these displacements are **not fully understood**. 2. Impingement and Entrainment: Screens are needed for both the warm and cold water intake systems to prevent debris and larger species from entering an OTEC facility. Impingement may occur where organisms become **trapped** against the intake screen. Smaller organisms which pass through the intake screen may be entrained through the system. Both could be **lethal** to the organisms. 3. Biocide Treatments: The warm water that is used in the OTEC facility would need to be treated with a biocide (e.g., chlorine) to maintain the efficiency of the heat exchangers in the OTEC facility. The amount of biocide needed will likely be less than the maximum discharge allowed under the Clean Water Act. 4. Other Potential Impacts: The electromagnetic field of the cable bringing the electricity to the shore may impact navigation and other behaviors of marine organisms. The platform presence may cause organism attraction or avoidance, and its mooring lines may cause entanglements. The noise generated from an OTEC facility may also impact marine mammals.

OTEC kills plankton [and other key organisms]

NOAA 10 — National Oceanic and Atmospheric Administration, scientific agency within the United States Department of Commerce, focused on the conditions of the oceans and the atmosphere, guides the use and protection of ocean and coastal resources, conducts research to improve understanding and stewardship of the environment, 2010 ("Ocean Thermal Energy Conversion: Assessing Potential Physical, Chemical and Biological Impacts and Risks", *NOAA*, June 22th, Available Online at http://coastalmanagement.noaa.gov/otec/docs/otecjun10wkshp.pdf, Accessed 7/31/14)

This report summarizes the group discussions on potential biological, chemical and physical impacts of OTEC. V. BREAKOUT GROUP REPORTS A. Warm Water Intake The warm water intake group examined the potential physical, chemical and biological impacts from the warm water intake system. The warm water intake system consists of the warm water intake pipe, intake screening, and any component with which warm water comes into contact with. The warm water intake is likely to be in relatively shallow water in an effort to capture the warmest water while at the same time avoiding surface disturbances such as wind and waves. Due to its relatively shallow depth, the principal impacts from the warm water intake system are likely to be entrainment and impingement. Entrainment, when an organism or particle passes through screening or filters and enters the warm water intake system, mostly affects small organisms that lack adequate mobility to escape the intake current. Classes of biota likely to become entrained in the warm water intake include: **phytoplankton**, zooplankton (including microzooplankton, meroplankton (e.g., larvae), icthyoplankton and

possibly macrozooplankton), as well as small fish. Once entrained, the biota may be subjected to mechanical and shear stresses from the intake pumps, periodic chemical stresses from the application of anti-fouling biocides, and temperature stress. The impact due to entrainment will vary with the intake screen mesh size, intake velocity and flow rate, survivability characteristics of organisms, and biological community composition and abundance in the region. For the warm-water intake discussions, it was assumed that there would be a **low survival rate** for organisms entrained. Impingement, when an organism is held against a surface by water flow or becomes stuck within a structure, is more likely to affect larger organisms. Classes of biota likely to become impinged against the warm water intake screening include macrozooplankton, cnidarians, small fish, and larger weak or sick fish. Healthy juvenile and adult sea turtles are unlikely to become entrained or impinged in the warm water intake, however, it is possible that sick or weakened individuals could. The magnitude, size and type of impinged organism would depend on the screen mesh size and design, intake velocity and flow, community composition and abundance of biota present in the area. If the magnitude of the direct effect (e.g., injury or death due to impingement, entrainment) is large enough, there are likely to also be indirect impacts, such as changes in the food web and behavior (i.e., shifting from predation to scavenging). The warm water intake system may also potentially impact diel migrations of micronekton, and may alter their local distribution and abundance. This will have a direct impact on the micronekton and their primary predators. The group concluded that **100% mortality of impinged or entrained organisms is likely**.

OTEC dangerously impacts marine organisms — inhibits basic biological functions

NOAA 10 — National Oceanic and Atmospheric Administration, scientific agency within the United States Department of Commerce, focused on the conditions of the oceans and the atmosphere, guides the use and protection of ocean and coastal resources, conducts research to improve understanding and stewardship of the environment, 2010 ("Ocean Thermal Energy Conversion: Assessing Potential Physical, Chemical and Biological Impacts and Risks", *NOAA*, June 22th, Available Online at http://coastalmanagement.noaa.gov/otec/docs/otecjun10wkshp.pdf, Accessed 7/31/14)

The noise and electromagnetic fields group examined the potential physical, chemical and biological impacts associated with the production of noise and electromagnetic fields associated with an OTEC facility. The generation of noise and electromagnetic fields (EMF) are of concern due to the large number of marine organisms that regularly use acoustics (e.g., dolphins, whales, fish) and electromagnetic fields (e.g., sharks, turtles) for communication, detection of prey/predators, and navigation. There are likely to be impacts associated with noise and electromagnetic fields, however, the magnitude and extent of the impact is not known and will likely depend on many factors. Sources of construction-related noise are likely to include: deployment of moorings, anchors and the power cable; deployment of the cold water pipe; and associated boat traffic. Sources of operational noise include turbines, pumps, discharge turbulence, cable strum (both mooring and power cable), cold water pipe vibration, boat traffic, and frictional noise from water movements. To date, very little direct measurements of the noise associated with OTEC facilities exist. The impact of noise will vary with receptor and exposure (i.e., magnitude, temporal, spatial, spectral), and will most likely manifest themselves as a physiological or behavioral impacts. Physiological impacts could include: hearing damage and loss (e.g., permanent threshold shift (PTS); temporary threshold shift (TTS)) and, in some species, could lead to death through inability to complete basic biological functions (e.g., echolocation for prey detection in dolphins). Behavioral changes may include local or widespread changes in movement (e.g., attractant, deterrent), communication difficulty due to masking, and changes in feeding and breeding habits (e.g., larval recruitment). If these behavioral changes persist, an ecosystem level impact may occur, potentially resulting in localized changes to community structure and food web dynamics. Electromagnetic field generation is likely limited to the power cable, with the section that is suspended between the seafloor and the

platform most likely to cause impacts. The receptivity and sensitivity to EMF is unknown for many species. Sensitive species (i.e., sea turtles, sharks) are most likely to be impacted, and if exposed, are likely to exhibit changes in behavior, including attraction and avoidance.

OTEC will have a significant negative impact on ocean ecosystems

Howell 10 – Writer and editor, Work has been published in the New York Times, USA Today, and the Scienfitic American (Katie Howell, "Wave Technologies Could Harm Marine Resources -- DOE Study", New York Times, 2/24/2010, http://www.nytimes.com/gwire/2010/02/24/24greenwire-wave-technologies-could-harm-marine-resources-95837.html)

Energy technologies that tap waves and tides could disrupt marine resources, the Energy Department found in a recent study. Marine and hydrokinetic technologies that capture energy from waves, tides and currents are poised to make a significant contribution to U.S. power supplies, but there is little known about their environmental impacts, the study (pdf) says. "There are well over 100 conceptual designs for converting the energy of waves, river and tidal currents and ocean temperature differences into electricity," the Office of Energy Efficiency and Renewable Energy report says. "However, because the concepts are new, few devices have been deployed and tested in rivers and oceans. Even fewer environmental studies of these technologies have been carried out, and thus potential environmental effects remain mostly speculative." But those effects could be significant. The report suggests projects could displace bottom-dwelling plants and animals or change their habitats by altering water flows and waves. And noise generated during installation and operation of energy conversion devices could interfere with communications of marine animals. Ocean thermal energy conversion, a technology that uses the temperature differences between warm surface waters and cold deep waters to generate electricity, could have additional impacts stemming from the intake and discharge of large volumes of water. Such operations could change water temperature and capture fish in intake and discharge plumes.

OTEC Crushes oceaen Bio D

Comfort and Vega 11 – Studying at University of Hawaii (Christina M Comfort and Luis Vega, "Environmental Assessment of Ocean Thermal Energy", August 2011, http://www.seaturtle.org/PDF/Ocr/ComfortCM_2011_InOceans11MTSIEEE1922September2011Kon_pxx-xx.pdf)

The operation of OTEC will impact organisms inhabiting or moving through the area to an unknown degree. Scientists have identified a list of potential biological impacts, including nutrient redistribution, entrainment and impingement, organism attraction or avoidance, and biocide release, among others [3]. To understand OTEC's ecological impact, long- term monitoring protocols are necessary to track primary productivity, animal abundance and density, habitat use, and entrainment rates. As with any offshore operation, the plant is likely to attract fish and seabirds, noise may interfere with animal communication, and lubricants or anti-biofouling chemicals may enter the ocean. Specifically concerning OTEC, the redistribution of millions of cubic meters of water per day will change stratification, salinity, oxygen, and nutrient levels near the site. Some organisms base their behavior on certain temperature or salinity gradients, e.g. [10], while others may be affected by increased nutrient levels [18]. Additionally, plankton and small nekton will be entrained in the water flow in both the shallow and deep intake pipes, and will likely suffer high mortality rates due to rapid temperature and pressure changes [4]. Organisms could be impinged against screens on the shallow water intakes if their burst swimming capacity does not overcome the current generated by the pipe [2, 3].

Environment Turn – Warming

OTEC will exacerbate the greenhouse effect

Fujita 90 – Staff Scientist for the New York Times, Author of the book Priorities for Marine Conservation (Rodney M Fujita, "Ocean Energy Raises Environment Issues", New York Times, 5/23/90, http://www.nytimes.com/1990/06/04/opinion/l-ocean-energy-raises-environment-issues-833990.html)

Some plans call for the use of R-22, a chlorofluorocarbon that is not completely ozone-friendly. It is also a powerful greenhouse gas. Planners should investigate fluids that are environmentally harmless. The potential for ecological disruption by ocean thermal energy conversion is enormous. It will work best in tropical regions, where the temperature difference between surface and deep water is greatest. Even when mixed with warm surface water to ameliorate environmental effects, the effluent carries a double shock to tropical marine ecosystems that have evolved within narrow temperature fluctuations and extremely low nutrient levels: the effluent is both cold and rich in nutrients. Advertisement Ocean energy conversion will bring deep water very rich in carbon dioxide to the surface. Some carbon will escape to the atmosphere, perhaps ex-acerbating the greenhouse effect. We also need to know how pumping large amounts of ancient deep water to the surface will affect ocean circulation and heat distribution.

Politics/Spending Links

OTEC extremely expensive and causes political controversy— trades off with other investment

Green Diary 11 — Green Diary, part of a network by Author, Speaker, Global Trainer and Publisher, 2011 ("The good, the bad and the ugly about ocean thermal energy conversion", *Green Diary*, November 10th, Available Online at http://www.greendiary.com/good-bad-ugly-ocean-thermal-energy-conversion.html, Accessed 7/29/14)

The bad **Transportation** The OTEC plants need large pipes, nearly 3km long, for transporting the cold water from 1000m below the surface of the ocean to the plants on the shore. The cost of constructing the large pipes accounts for about **75% of the design cost**. Discharging of the cold and warm seawater The warm and cold water discharged from the OTEC plants could affect the temperature of the coastal fringes. To avoid any adverse impact, the used seawater needs to be discharged at comparable temperature gradients. This further **escalates the construction and maintenance costs** of the plants. Can this be avoided? The high costs involved in transportation of cold seawater and construction of discharge pipes could be resolved by building floating OTEC facilities. However, a floating plant requires high mooring and maintenance cost. The ugly **Cost** The high construction and maintenance cost are the major deterrents in using OTEC as a renewable power source. The cost of producing electricity by an OTEC unit is approximately $0.07 per KW-hour. Developing countries lack the resource for constructing OTEC plants. **Political concerns** The floating OTEC plants are essentially artificial islands. Location of these facilities on the sea might lead to political debates regarding the **jurisdiction** of the region. The boundary disputed that might erupt would inhibit utilization of the solar energy trapped in the seawater. Why are we so critical? The major criticism against the OTEC plant is the **exorbitant cost** of constructing the infrastructure for the facilities. The huge investment needed for building the OTEC plants would create a **dearth of resources** that might be otherwise used for financing the social sector.

Politics Link / States CP Solvency

Plan unpopular with Congress — states solve

Friedman 14 — Rebecca Friedman, AB from Harvard University, 2014 ("EXAMINING THE FUTURE OF OCEAN THERMAL ENERGY CONVERSION", *Harvard Political Review*, March, Available Online at http://www.oceanenergycouncil.com/examining-future-ocean-thermal-energy-conversion/, Accessed 7/29/14)

Given the **risks**, **costs**, and **uncertain popularity** of OTEC, it seems unlikely that federal support for OTEC is forthcoming. Jim Anderson, co-founder of Sea Solar Power Inc., a company specializing in OTEC technology, told the HPR, "Years ago in the '80s, there was a small [governmental] program for OTEC and it was abandoned…That philosophy has carried forth to this day. There are a few people in the Department of Energy who have blocked government funding for this. It's not the Democrats, not the Republicans. It's a **bureaucratic issue**." OTEC is not completely off the government's radar, however. This past year, for the first time in a decade, Congress debated reviving the oceanic energy program in the energy bill, although the proposal was ultimately defeated. OTEC even enjoys some support on a **state level.** **Hawaii** 's National Energy Laboratory, for example, conducts OTEC research around the islands. For now, though, American interests in OTEC promise to remain largely academic. The Naval Research Academy and Oregon State University are conducting research programs off the coasts of **Oahu** and **Oregon** , respectively.

***brackets in original text

Spending Links/Solvency

Costs over 1 billion dollars just for first plant - Too expensive for widespread adoption – even with economies of scale

Cooper et al 09 – This paper was presented at the 2009 Offshore Technology Conference held in Houston, Texas, USA (D.J. Cooper, L.E. Meyer, R.J. Varley, Lockheed Martin Corporation, "OTEC Commercialization Challenges", Offshore Technology Conference, 4/17/2009, http://www.gl-nobledenton.com/en/news.php?myPath=/en/news/11739.php)

The technical design includes an overarching requirement to minimize cost. We believe our first 100MW plant will cost **well over one billion dollars** to install. As with other utility projects, OTEC plants are capital intensive and will require some form of commercial financing for the project to go forward. Like the real estate mantra – location, location, location; the OTEC mantra has to be cost, cost, and cost. Financing reimbursements are made over time via fixed price power purchase agreements. Minimizing the capital plant cost and the subsequent operation and maintenance costs is critical to a sound business case. Figure 5 is a simplistic view of capital cost amortization but serves as a good example of OTEC scalability (data in the figure do not include ordinate is the cost of electricity assuming 11% return on investment after 20 years. For example, with these assumptions, a capital cost of $150 million requires a cost of electricity of 29 cents per kilowatt-hour. Also shown to the right of the graph are approximate cost of electricity ranges for the Navy base at Diego Garcia in the Indian Ocean, the Hawaiian island of Oahu, and typical values for continental United States (CONUS). At small megawatt scales, it will be difficult for OTEC to be economically viable in any but the most expensive markets. Larger plants provide linearly larger revenues to repay capital costs that do not linearly scale. The first plant is expected to be the most expensive plant. For that reason, Hawaii is a favorable initial market. Energy costs are higher there than on the mainland. Follow-on plants will benefit from in-place processes and procedures and from manufacturing learning curves. Additional savings should be available from multi-plant orders and technology innovation.

Costs are massive – also proves can't economically compete enough for widespread adoption

Friedman 14 – Research Associate with the Center for Preventive Action and the program on International Institutions and Global Governance at the Council on Foreign Relations. She holds an AB from Harvard University, where she was Editor-in-Chief of the Harvard Political Review (Rebecca Friedman, "Examining The Future of Ocean Thermal Energy Conversion", Ocean Energy Council, 3/26/14, http://www.oceanenergycouncil.com/examining-future-ocean-thermal-energy-conversion/)

Despite the sound science, a fully functioning OTEC prototype has yet to be developed. The high costs of building even a model pose the main barrier. Although piecemeal experiments have proven the effectiveness of the individual components, a large-scale plant has never been built. Luis Vega of the Pacific International Center for High Technology Research estimated in an OTEC summary presentation that a commercial-size five-megawatt OTEC plant could cost from 80 to 100 million dollars over five years. According to Terry Penney, the Technology Manager at the National Renewable Energy Laboratory, the combination of cost and risk is OTEC's main liability. "We've talked to inventors and other constituents over the years, and it's still a matter of huge capital investment and a huge risk, and there are many [alternate forms of energy] that are less risky that could produce power with the same certainty," Penney told the HPR. Moreover, OTEC is highly vulnerable to the elements in the marine environment. Big storms or a hurricane like Katrina could completely disrupt energy production by mangling the OTEC plants. Were a country completely dependent on oceanic energy, severe weather could be debilitating. In addition, there is a risk that the salt water surrounding an OTEC plant would cause the

machinery to "rust or corrode" or "fill up with seaweed or mud," according to a National Renewable Energy Laboratory spokesman. Even environmentalists have impeded OTEC's development. According to Penney, people do not want to see OTEC plants when they look at the ocean. When they see a disruption of the pristine marine landscape, they think pollution. Given the risks, costs, and uncertain popularity of OTEC, it seems unlikely that federal support for OTEC is forthcoming. Jim Anderson, co-founder of Sea Solar Power Inc., a company specializing in OTEC technology, told the HPR, "Years ago in the '80s, there was a small [governmental] program for OTEC and it was abandoned…That philosophy has carried forth to this day. There are a few people in the Department of Energy who have blocked government funding for this. It's not the Democrats, not the Republicans. It's a bureaucratic issue."

Building OTEC plants is expensive

OEC 14 – provides public knowledge about ocean energy and aim to educate (Ocean Energy Council, "WHAT IS THE COST OF OTEC ENERGY?", 3/25/14, http://www.oceanenergycouncil.com/ocean-energy/otec-energy/cost-otec-energy/)

At the present time, despite the fact that OTEC systems have no fuel costs and can produce useful by-products, the high initial cost of building such power plants makes OTEC generated electricity more expensive than conventional alternatives. As such, OTEC systems at the present time are restricted to experimental and demonstration units. Island nations which currently rely on expensive, imported fossil fuels for electrical generation are the most promising market for OTEC. More experience in building OTEC power plants and standardized plant designs could bring OTEC costs down in the future. Heightened world concern over environmental issues such as global warming could also hasten the development of OTEC as a practical source of electricity.

Oil Dependence Good

Oil Dependence establishes leverage over threat countries

Fisher 10 — Max Fisher, master's in security studies from Johns Hopkins University, 2010 ("The Upside of Depending on Foreign Oil", *The Atlantic*, April 2nd, Available Online at http://www.theatlantic.com/international/archive/2010/04/the-upside-of-depending-on-foreign-oil/38380/, Accessed 7/31/14)

As a result, buying Saudi oil gets us a lot more than just energy. It gets us a dedicated ally that wields unparalleled influence in a part of the world where we desperately need it: the Middle East. The Saudi royal family has put their wily intelligence service at our disposal and allowed sprawling U.S. military bases onto their soil. In 1992, the Saudis even exiled one of their own on America's behalf: A prominent, wealthy, and popular humanitarian and freedom fighter named Osama bin Laden. Saudi royalty risked a violent backlash by expelling bin Laden to Sudan, but U.S. officials had demanded his ouster. That's no small favor. It would be almost as if the United States deported Google CEO Eric Schmidt to Honduras at the request of angry Chinese officials. The Saudis came to our aid again in 1996 when they convinced the Sudanese regime to themselves deport bin Laden. Bin Laden's anti-American terrorism did not begin until he fled to Afghanistan, where the United States then had little influence. In the decade since, he has moved between there and Pakistan, two countries with which the U.S. has no meaningful economic ties save foreign aid. Unlike with Saudi Arabia, our pleas to those governments to help us rout bin Laden went largely ignored. If our oil-greased relationships with other top producing states are half as close as the U.S.-Saudi partnership, it will give us much-needed leverage over some of this century's biggest emerging threats. In Nigeria, we can pressure the government to peacefully contain the state's alarming increase in terrorism. For Iraq, the economic ties with America would be an important counterbalance to Iran's religious and political influence. As for Venezuela, no matter how antagonistic President Hugo Chavez gets, he would be a lot worse if we didn't take close to a million barrels off his hands every day.

Oil Dependence good — increases Dollar value — tunnel vision strategy should be rejected

Mutasem 12 — Sam Mutasem, Senior Executive in the power industry with 25 years experience, former Managing Director for a fortune 500 independent power company, B.S degree from the University of Texas, MBA from the University of Houston, member of the Board of Directors at Circle Energy Oil & Gas, the American Management Association and the Gulf Coast Power Association, 2012 ("Dependence on Oil...Good or Bad?", *EnergyBiz*, March 1st, Available Online at http://www.energybiz.com/article/12/03/dependence-oilgood-or-bad, Accessed 7/31/14)

One fact that most do not realize is that all the oil traded globally is nominated in US dollar. What does that mean? As the demand on oil increase so does the price. As a result the demand on the US dollar will increase and so will the purchasing power of the American Consumer. The Dollar...remains King! Therefore the drive to reduce dependence on oil may have its benefits, but it will come at a cost that should be mitigated as an integral part of the strategy to reduce dependence on oil. Reducing dependence on oil cannot be approached with a tunnel vision strategy because the lower the dependence on oil the lower the demand on the dollar and the lower the purchasing power of the American consumer. So, what is more...a matter of National Security?

[Note: Ellipses found in article]

Foreign Oil Dependence best — alternatives too expensive and lack capability

Powell 11 — Jim Powell, Senior Fellow at the Cato Institute, contributor to Forbes Magazine, 2011 ("Why 'Dependence' On Foreign Oil Is A Bogus Worry", *Forbes*, November 15th, Available Online at http://www.forbes.com/sites/jimpowell/2011/11/15/global-oil-and-gas-markets-our-best-energy-security/, Accessed 7/31/14)

This idea has been embraced by every president since Nixon. Mainly it has meant (1) federal subsidies for "green" companies that go bankrupt and (2) higher energy costs for American taxpayers. In recent decades, the federal government has spent tens of billions of dollars on energy projects that accomplished nothing. If "independence" ever included protectionist measures to block foreign oil – imported because it's a lower-cost option — American consumers would be socked to pay higher energy prices. It makes as little sense to worry about our "dependence" on foreign oil as it does to worry about our "dependence" on private enterprise, computers and other wonders. We would be worse off doing things that **cost more** or **don't work** as well. We should make the most of our comparative advantages. Keep in mind that major oil producers have strong incentives to sell their oil. In most cases, it dominates their economies and generates a substantial percentage of government revenues. Moreover, many of these countries live beyond their means. They have spent huge sums on weapons, wars, palaces, religious police and money-losing nationalized industries. Generally the major oil producers have failed to diversify their revenue sources by providing an attractive business climate where different industries could develop.

China CP Solvency

China solves — key testing area

Hall 14 — Simon Hall, Resources Editor for The Wall Street Journal, former Managing Editor on Energy for Dow Jones and Company, 2014 ("China's New Wager: Pulling Energy From the Ocean", *The Wall Street Journal*, March 31st, Available Online at http://online.wsj.com/news/articles/SB10001424052702303287804579446904069462752, Accessed 8/3/14)

HONG KONG—A race is under way to unlock one of the world's biggest untapped sources of clean energy—the ocean—with China emerging as an important testing ground. That could heighten competition with Western companies, especially if Chinese businesses begin using technologies developed with joint-venture partners to expand rapidly. The European Union so far has led efforts to harness the sea to make electricity, for which there are three principal techniques: underwater turbines that draw power from the ebb and flow of tides, surface-based floats that rely on wave motion and systems that exploit differences in water temperature. The world's first commercial, grid-connected tidal-flow generator was installed in Northern Ireland in 2008. Germany's Siemens AG SIE.XE -2.47% , a big investor in wave and tidal power, predicts that tidal currents alone could someday power 250 million households world-wide. France's Alstom SA ALO.FR -0.37% also is developing the technology. But with 11,000 miles of coastline rich with energy potential and pollution that is getting worse, China is seen by many experts as an ideal location to pioneer and commercialize ocean-energy technologies. China is stepping up spending in the sector, and foreign companies including U.S.-based Lockheed Martin Corp. LMT +0.09% are testing equipment and entering joint ventures in the country. Among the projects under study with Chinese backing: the dynamic tidal-power wall, with turbines using curved blades that are designed to allow eels and fish to pass through safely. If approved, the wall could supply as much electricity as 2½ large nuclear reactors—and cost as much as $30 billion. Investors include the Netherlands government and a consortium of eight Dutch companies, including engineering firms Arcadis ARCAY -1.51% NV and Strukton Groep NV. The venture dwarfs other sea-power projects and could produce electricity more cheaply than offshore wind farms, says Dimiti de Boer, a senior adviser for environment and climate change at the United Nations Industrial Development Organization. The project involves building a wall running perpendicular from the coast and then branching off into a T, extending around 20 miles and studded with turbines that would channel and concentrate the power of tidal water. Beijing provided $3.3 million for feasibility studies that are under way in China. Construction is at least a decade away, though initial findings suggest that shallow waters on the Chinese, Korean and European coasts could be suitable. "China is at the cutting edge" in sea-energy technology development, says Mr. de Boer, who is based in Beijing. Making electricity from the sea still is far more costly than using coal, oil, nuclear reactors or wind, and some technologies being tested in China could prove impractical. Since 2010, Beijing has spent around one billion yuan, or roughly $160 million, on energy from the sea, says Wang Chuankun, a former head of the ocean-energy committee of the China Renewable Energy Society academic association. Atlantis Resources contracted with China's Dongfang Electric to produce low-cost, underwater turbines. Overall private investment in sea-energy projects in Europe has reached about $825 million over the past seven years, and the U.S. Energy Department is supporting several Pacific Coast research ventures. Chile, Australia and other countries also have substantial projects under way. Many people in the industry believe China will be key, however. Lockheed is working with Chinese conglomerate Reignwood Group, to build the **world's first large-scale, ocean thermal-energy conversion** power station. The companies plan to decide by June where in Asia to build the 10-megawatt facility, which will use warm surface water to heat ammonia, which has a low boiling point, making steam to drive a turbine without carbon emissions. The steam is then condensed using deeper, colder water and the cycle is repeated, producing a constant flow of electricity costing around 15 cents a kilowatt-hour. That is more expensive than nuclear power but well below the 22 cents for offshore wind turbines, according to the U.S. Energy Information Administration. Ten megawatts is enough to power about 10,000 Western households.

China Solves

Quick 13 — Darren Quick, contributor for Gizmag — a magazine-style website that has covered technology news for over a decade, 2013 ("World's largest OTEC power plant planned for China", *Gizmag*, April 18, Available Online at http://www.gizmag.com/otec-plant-lockheed-martin-reignwood-china/27164/, Accessed 8/3/14)

Lockheed Martin has been getting its feet wet in the renewable energy game for some time. In the 1970s it helped build the world's first successful floating Ocean Thermal Energy Conversion (OTEC) system that generated net power, and in 2009 it was awarded a contract to develop an OTEC pilot plant in Hawaii. That project has apparently been canceled but the company has now shifted its OTEC sights westward by teaming up with Hong Kong-based Reignwood Group to co-develop a pilot plant that will be built off the coast of southern China. Tropical regions are considered the only viable locations for OTEC plants due to the great...A closed-cycle OTEC system OTEC plants are located off-shore OTEC uses the natural difference in temperatures between the cool deep water and warm surface water to produce electricity. There are different cycle types of OTEC systems, but the prototype plant is likely to be a

closed-cycle system. This sees warm surface seawater pumped through a heat exchanger to vaporize a fluid with a low boiling point, such as ammonia. This expanding vapor is used to drive a turbine to generate electricity with cold seawater then used to condense the vapor so it can be recycled through the system. Tropical regions are considered the only viable locations for OTEC plants due to the greater temperature differential between the shallow and deep water. Unlike wind and solar power, OTEC can produce electricity around the clock, 365 days a year to supply base load power. OTEC plants also produce cold water as a by-product that can be used for air conditioning and refrigeration at locations near the plant. Despite such advantages, and even though demonstration plants were constructed as far back as the 1880s, there are still no large-scale commercial OTEC plants in operation. This is largely due to the costs associated with locating and maintaining the facility off shore and drawing the cold water from the ocean depths. But the time may finally be right. With the shelving of the Hawaii OTEC pilot plant, the 10 MW prototype offshore plant will be the largest planned OTEC project to date. Like the Hawaii project, which was also to be a 10 MW facility, the China OTEC plant is designed to pave the way for higher capacity plants ranging from 10 to 100 MW. OTEC plants are located off-shore The plant is to be built off the coast of southern China to supply 100 percent of the power needed for a large-scale green resort community being developed by Reignwood Group. The new resort is planned as Reignwood's first net-zero community, with the company also currently developing two large-scale low-carbon resorts and others planned for key locations in China. Lockheed Martin and Reignwood will begin concept design of the sea-based prototype plant this year with construction due to begin next year. Once it is up and running, the two companies plan to use the knowledge and experience gained over the course of the project to improve the design of additional commercial-scale plants. The companies claim each 100 MW OTEC facility could produce the same amount of energy in a year as 1.3 million barrels of oil and decrease carbon emissions by half a million tons. Assuming oil trading at near US$100 a barrel, they estimate fuel savings from one plant could exceed $130 million a year.

Random - Hydrogen Economy Fails

Hydrogen energy fails — technical barriers and high costs

TCPA 8 — Texas Comptroller of Public Accounts, releaser of The Energy Report —is a reference tool for anyone seeking to understand the current Texas energy environment. Texas remains at the forefront of the nation's energy industry. The direction Texas takes in energy policy will help mark the path for the nation, 2008 ("Hydrogen", THE ENERGY REPORT, May 2008, Available Online at http://www.window.state.tx.us/specialrpt/energy/renewable/h2.php, Accessed 7/28/14)

Hydrogen is colorless, odorless, tasteless and non-toxic. It is a gas at temperatures above -423° F and is highly diffuse, having a density approximately 14 times less than that of air. Because it is buoyant and diffusive, hydrogen dissipates quickly in open areas and can move through small spaces, which makes it difficult to store. Hydrogen is flammable over a broad range of gas concentration (from 4 to 74 percent), although its lower flammability limit – that is, the lowest temperature and pressure at which it will combust – is higher than those for some common fuels such as gasoline, propane or diesel.1 Hydrogen has been described as "the fuel of the future." On Earth, hydrogen is found in combination with other elements such as carbon (hydrocarbons), oxygen (water) and nitrogen (ammonia). Although hydrogen may sometimes be used as a fuel, it is most often used as an energy carrier, such as electricity, and **not an energy source**. To make hydrogen a usable, stand-alone fuel, it must be separated from these other elements by chemical, thermal or electrochemical processes. Hydrogen can be separated from water using the heat of the sun, for example, and then used as a power source. After it is combined with oxygen to produce power, the only emission is water (Exhibit 22-1). Even so, hydrogen has been described as "the fuel of the future." Because it is abundant and benign in terms of emissions, proponents say it holds tremendous promise. Due to **technical barriers** and resulting **high costs**, however, **even its ardent supporters** do not see hydrogen power as a short-term solution for America's energy needs. Nonetheless, growing interest in the issue of carbon emissions has spurred hydrogen activity around the world, particularly in Europe, Japan and California. Use of hydrogen for energy purposes is in a developmental stage, so the economic effects in Texas are largely limited to grant funds for research and pilot projects.

Doesn't solve Warming or Oil Dependence

Brain 2 — Marshall Brain, founder of HowStuffWorks, bachelor's degree in electrical engineering from Rensselaer Polytechnic Institute, master's degree in computer science from North Carolina State University, 2002 ("How the Hydrogen Economy Works", *HowStuffWorks*, January 16th, Available Online at http://auto.howstuffworks.com/fuel-efficiency/fuel-economy/hydrogen-economy4.htm, Accessed 7/28/14)

Reforming fossil fuels - Oil and natural gas contain hydrocarbons -- molecules consisting of hydrogen and carbon. Using a device called a fuel processor or a reformer, you can split the hydrogen off the carbon in a hydrocarbon relatively easily and then use the hydrogen. You discard the leftover carbon to the atmosphere as carbon dioxide. The second option is, of course, slightly perverse. You are using fossil fuel as the source of hydrogen for the hydrogen economy. This approach reduces air pollution, but it doesn't solve either the greenhouse gas problem (because there is still carbon going into the atmosphere) or the dependence problem (you still need oil). However, it may be a good temporary step to take during the transition to the hydrogen economy. When you hear about "fuel-cell-powered vehicles" being developed by the car companies right now, almost all of them plan to get the hydrogen for the fuel cells from gasoline using a reformer. The reason is because gasoline is an easily available source of hydrogen. Until there are "hydrogen stations" on every corner like we have gas stations now, this is the easiest way to obtain hydrogen to power a vehicle's fuel cell.